Introduction to Statistics
Math 1040
Sample Exam III – Chapters 8-10
4 Problem Pages – 3 Formula/Table Pages
Time Limit: 90 Minutes[1] No Scratch Paper Calculator Allowed: Scientific

Name:_____

The point value of each problem is in the left-hand margin. You must show your work to receive any credit, except on problems 1 & 2. Work neatly.

(6) 1. Fill in the blanks.

(a) For df = 18, $t_{0.001}$ = .

(b) The type I error occurs if when .

(c) We can decrease the width of a confidence interval by the sample size.

(6) 2. True or False.

( ) (a) If in a hypothesis test, the P-value = 0.05, then we reject the null hypothesis at the $\alpha = 0.01$ level of significance.

( ) (b) A 95% confidence interval mean the parameter value is contained in 95% of confidence intervals obtained from appropriate samples.

( ) (c) For a population of size N and population proportion p, the standard deviation of sample proportions of random samples of size n with $n \leq 5\%N$, is $\sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$.

(8) 3. It is claimed that the average weight of American women is now more than 165 pounds. Suppose a random survey of 35 American women resulted in the average weight of 162 pounds with the standard deviation of 5.2 pounds. Based on this data, can we reject the claim that the average weight of American women is now more than 165 pounds? Show the test completely and clearly.

[1] **If you exceed the time limit, you will receive a score of zero.**

(8) 4. In an unbalanced die, 25 of 100 rolls resulted in a six. Find the 95% confidence interval for the proportion of rolls that will result in a six. State the formula used and justify it. Show your work.

(10) 5. Suppose a nutritionist wants to estimate of mean height of 18-25 year old males.

(a) A previous study indicated that the standard deviation of the height of such males is 1.38 inches. What sample size should he use if he wants to estimate the average height of 18-25 year old males to withing 0.5 inches with 99% level of confidence? State the formula used and show your work.

(b) A random sample of 35 such males resulted in mean height of 70.5 inches with the standard deviation of 1.72 inches. Find a 95% confidence interval for the mean height of 18-25 year old males. State the formula used and show your work.

(6) 6. Suppose the mean GPA of all WSU students is 2.85 with the standard deviation of 0.78. Let $\overline{x}$ be the mean GPA of a random sample of 30 WSU students. Find the probability that $\overline{x}$ is between 2.79 and 3.05. Show your work.

(8) 7. Suppose in the United States 60% of murders are committed with a firearm. Let $\hat{p}$ be the proportion of murders committed by a firearm in a random sample of 42 murders. Find the probability that $\hat{p}$ is greater than 62%. Show your work.

(6) 8. We want to determine the percentage of WSU students who are not punctual. What size sample should we obtain if we want to limit the margin of error to 0.5% with a level of confidence of 99%? State the formula used and show your work.

(10) 9. According to the U.S. Census Bureau, the probability that a randomly selected household speaks only English at home is 0.81. We want to test figure in two ways. Suppose a random sample of 1320 households indicated that 1005 households speak only English at home. Does the evidence suggest that the proportion of household who speaks only English at home is not 0.81 at the $\alpha = 0.01$ level of significance? Construct and interpret a 90% confidence interval for the proportion of household who speaks only English at home. According to this confidence interval, can the U.S. Census Bureau figure be correct? Show the test completely and clearly. State the formula used for the confidence interval.

(7) 10. It is believed that the mean length of human pregnancies is 266 days. A random sample of 38 pregnant women resulted in the mean length of pregnancies of 260 days with the standard deviation of $\sigma = 16$ days. Does the evidence suggest that the mean length of human pregnancies is less than 266 days at the $\alpha = 0.01$ level of significance? Show the test completely and clearly.

Formulas

$$Z = \frac{X-\mu}{\sigma}\,, \quad \mu_{\overline{x}} = \mu \ , \quad \mu_{\hat{p}} = p \ , \quad \sigma_{\overline{x}} = \frac{\sigma}{\sqrt{n}}\,, \quad \sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$$

$$\hat{p} \pm Z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}\,, \quad E = Z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}\,, \quad n = \hat{p}(1-\hat{p}) \left(\frac{Z_{\frac{\alpha}{2}}}{E}\right)^2 \,, \quad n = 0.25 \left(\frac{Z_{\frac{\alpha}{2}}}{E}\right)^2$$

$$t = \frac{\overline{x}-\mu}{\frac{s}{\sqrt{n}}}\,, \quad \overline{x} \pm t_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}}\,, \quad n = \left(\frac{Z_{\frac{\alpha}{2}}\, s}{E}\right)^2$$

$$z_0 = \frac{\hat{p}-p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}\,, \quad t_0 = \frac{\overline{x}-\mu_0}{\frac{s}{\sqrt{n}}}$$

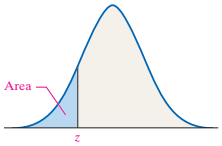

Table V

Standard Normal Distribution

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
−3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
−3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
−3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
−3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
−2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
−2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
−2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
−2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
−2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
−2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
−2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
−2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
−2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
−2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
−1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
−1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
−1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
−1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
−1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
−1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
−1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
−1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
−1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
−1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
−0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
−0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
−0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
−0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
−0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
−0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
−0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
−0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
−0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
−0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

Confidence Interval Critical Values, $z_{\alpha/2}$

Level of Confidence	Critical Value, $z_{\alpha/2}$
0.90 or 90%	1.645
0.95 or 95%	1.96
0.98 or 98%	2.33
0.99 or 99%	2.575

Hypothesis Testing Critical Values

Level of Significance, α	Left Tailed	Right Tailed	Two-Tailed
0.10	−1.28	1.28	±1.645
0.05	−1.645	1.645	±1.96
0.01	−2.33	2.33	±2.575

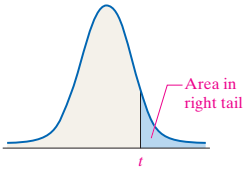

Table VI

t-Distribution
Area in Right Tail

df	0.25	0.20	0.15	0.10	0.05	0.025	0.02	0.01	0.005	0.0025	0.001	0.0005
1	1.000	1.376	1.963	3.078	6.314	12.706	15.894	31.821	63.657	127.321	318.309	636.619
2	0.816	1.061	1.386	1.886	2.920	4.303	4.849	6.965	9.925	14.089	22.327	31.599
3	0.765	0.978	1.250	1.638	2.353	3.182	3.482	4.541	5.841	7.453	10.215	12.924
4	0.741	0.941	1.190	1.533	2.132	2.776	2.999	3.747	4.604	5.598	7.173	8.610
5	0.727	0.920	1.156	1.476	2.015	2.571	2.757	3.365	4.032	4.773	5.893	6.869
6	0.718	0.906	1.134	1.440	1.943	2.447	2.612	3.143	3.707	4.317	5.208	5.959
7	0.711	0.896	1.119	1.415	1.895	2.365	2.517	2.998	3.499	4.029	4.785	5.408
8	0.706	0.889	1.108	1.397	1.860	2.306	2.449	2.896	3.355	3.833	4.501	5.041
9	0.703	0.883	1.100	1.383	1.833	2.262	2.398	2.821	3.250	3.690	4.297	4.781
10	0.700	0.879	1.093	1.372	1.812	2.228	2.359	2.764	3.169	3.581	4.144	4.587
11	0.697	0.876	1.088	1.363	1.796	2.201	2.328	2.718	3.106	3.497	4.025	4.437
12	0.695	0.873	1.083	1.356	1.782	2.179	2.303	2.681	3.055	3.428	3.930	4.318
13	0.694	0.870	1.079	1.350	1.771	2.160	2.282	2.650	3.012	3.372	3.852	4.221
14	0.692	0.868	1.076	1.345	1.761	2.145	2.264	2.624	2.977	3.326	3.787	4.140
15	0.691	0.866	1.074	1.341	1.753	2.131	2.249	2.602	2.947	3.286	3.733	4.073
16	0.690	0.865	1.071	1.337	1.746	2.120	2.235	2.583	2.921	3.252	3.686	4.015
17	0.689	0.863	1.069	1.333	1.740	2.110	2.224	2.567	2.898	3.222	3.646	3.965
18	0.688	0.862	1.067	1.330	1.734	2.101	2.214	2.552	2.878	3.197	3.610	3.922
19	0.688	0.861	1.066	1.328	1.729	2.093	2.205	2.539	2.861	3.174	3.579	3.883
20	0.687	0.860	1.064	1.325	1.725	2.086	2.197	2.528	2.845	3.153	3.552	3.850
21	0.686	0.859	1.063	1.323	1.721	2.080	2.189	2.518	2.831	3.135	3.527	3.819
22	0.686	0.858	1.061	1.321	1.717	2.074	2.183	2.508	2.819	3.119	3.505	3.792
23	0.685	0.858	1.060	1.319	1.714	2.069	2.177	2.500	2.807	3.104	3.485	3.768
24	0.685	0.857	1.059	1.318	1.711	2.064	2.172	2.492	2.797	3.091	3.467	3.745
25	0.684	0.856	1.058	1.316	1.708	2.060	2.167	2.485	2.787	3.078	3.450	3.725
26	0.684	0.856	1.058	1.315	1.706	2.056	2.162	2.479	2.779	3.067	3.435	3.707
27	0.684	0.855	1.057	1.314	1.703	2.052	2.158	2.473	2.771	3.057	3.421	3.690
28	0.683	0.855	1.056	1.313	1.701	2.048	2.154	2.467	2.763	3.047	3.408	3.674
29	0.683	0.854	1.055	1.311	1.699	2.045	2.150	2.462	2.756	3.038	3.396	3.659
30	0.683	0.854	1.055	1.310	1.697	2.042	2.147	2.457	2.750	3.030	3.385	3.646
31	0.682	0.853	1.054	1.309	1.696	2.040	2.144	2.453	2.744	3.022	3.375	3.633
32	0.682	0.853	1.054	1.309	1.694	2.037	2.141	2.449	2.738	3.015	3.365	3.622
33	0.682	0.853	1.053	1.308	1.692	2.035	2.138	2.445	2.733	3.008	3.356	3.611
34	0.682	0.852	1.052	1.307	1.691	2.032	2.136	2.441	2.728	3.002	3.348	3.601
35	0.682	0.852	1.052	1.306	1.690	2.030	2.133	2.438	2.724	2.996	3.340	3.591
36	0.681	0.852	1.052	1.306	1.688	2.028	2.131	2.434	2.719	2.990	3.333	3.582
37	0.681	0.851	1.051	1.305	1.687	2.026	2.129	2.431	2.715	2.985	3.326	3.574
38	0.681	0.851	1.051	1.304	1.686	2.024	2.127	2.429	2.712	2.980	3.319	3.566
39	0.681	0.851	1.050	1.304	1.685	2.023	2.125	2.426	2.708	2.976	3.313	3.558
40	0.681	0.851	1.050	1.303	1.684	2.021	2.123	2.423	2.704	2.971	3.307	3.551
50	0.679	0.849	1.047	1.299	1.676	2.009	2.109	2.403	2.678	2.937	3.261	3.496
60	0.679	0.848	1.045	1.296	1.671	2.000	2.099	2.390	2.660	2.915	3.232	3.460
70	0.678	0.847	1.044	1.294	1.667	1.994	2.093	2.381	2.648	2.899	3.211	3.435
80	0.678	0.846	1.043	1.292	1.664	1.990	2.088	2.374	2.639	2.887	3.195	3.416
90	0.677	0.846	1.042	1.291	1.662	1.987	2.084	2.368	2.632	2.878	3.183	3.402
100	0.677	0.845	1.042	1.290	1.660	1.984	2.081	2.364	2.626	2.871	3.174	3.390
1000	0.675	0.842	1.037	1.282	1.646	1.962	2.056	2.330	2.581	2.813	3.098	3.300
z	0.674	0.842	1.036	1.282	1.645	1.960	2.054	2.326	2.576	2.807	3.090	3.291

Introduction to Statistics
Math 1040
Additional (not on the Sample Exam) Review Problems for Chapters 8-10

This is not an exhaustive list of all possible types of problems.

1. Fill in the blanks.

   (a) All else equal, a 95% confidence interval has a _____ width than a 90% confidence interval.

   (b) $\alpha = P($ _____ $)$.

   (c) For a population with standard deviation σ, the standard deviation of samples means of random samples of size 36 is $\sigma_{\overline{x}} =$ _____ .

   (d) For a population of size N and population proportion p, the mean of sample proportions of random samples of size n with $n \leq 5\%N$, is $\mu_{\hat{p}} =$ _____ .

   (e) The Type II error is the error of _____ the null hypothesis when the alternative hypothesis is ture. .

   (f) If a prior estimate of population proportion is not known, then we use $\hat{p} =$ _____ for calculating the required sample size for a population proportion confidence interval.

2. True or False.

( ) (a) All else equal, we can decrease the width of a confidence interval by increasing the sample size.

( ) (b) The sample means of random samples of size 30 are normally distributed.

( ) (c) For a 99% confidence interval, $\alpha = 0.005$.

( ) (d) In a right-tailed mean test, we can reject the null hypothesis only if the observed mean data is statistically significantly greater than μ_0 .

( ) (e) We can reject the null hypothesis for any level of significance $\alpha > P$-value .

( ) (f) $Z_\alpha > t_\alpha$.

3. Suppose the average annual income WSU students is \$14,500 with a standard deviation of \$5,100. Let $\overline{x}$ be the average annual income of 32 randomly chosen WSU students.

   (a) Describe the sampling distribution of the sample mean $\overline{x}$ and state the mean and standard deviation of $\overline{x}$.

   (b) What is the probability that the the average annual income $\overline{x}$ is less than \$13,700? Express this probability in mathematical symbols and show your work.

4. Suppose the pass rate of Math 1040 classes is normally distributed with the mean of 76% and standard deviation of 3%. Let $\overline{x}$ be the mean pass rate of a sample of 8 Math 1040 classes. What is the probability that the mean pass rate $\overline{x}$ is greater than 78.5%? Express this probability in mathematical symbols and show your work.

5. Suppose 10% of WSU students miss one or more classes per week. Suppose 132 WSU students is randomly chosen. Let $\hat{p}$ be the proportion of WSU students in the sample who missed one or more classes in the last week.

   (a) Describe the sampling distribution of the sample proportion $\hat{p}$ and state the mean and standard deviation of $\hat{p}$.

   (b) What is the probability that the sample proportion $\hat{p}$ exceeds 7%? Express this probability in mathematical symbols and show your work.

6. Suppose 35% of eligible voters will not vote in a presidential election. Let $\hat{p}$ be the proportion of eligible votes who will not vote in the upcoming presidential election in a sample of 80 randomly chosen eligible voters. What is the probability that the sample proportion $\hat{p}$ is less than 30%? Express this probability in mathematical symbols and show your work.

7. A random sample of 1200 of Utah voters indicated that 281 of them will not vote for either Hillary Clinton or Donald Trump. Find a 95% confidence interval for the proportion of Utah voters that will not for either Hilary Clinton or Donald Trump. Interpret this confidence interval. State the formula used.

8. A sociologist wishes to estimate the percentage of the United States population living in poverty. What size sample should be obtained if the sociologist wants to limit the margin of error to 2% with 99% confidence if

   (a) the sociologist has no prior estimate? State the formulas used.

   (b) the sociologist uses the estimate of 11.8%? State the formulas used.

9. A random sample of 72 full-term babies indicated a mean birth weight of $\overline{x} = 3,450$ grams and a standard deviation of $s = 510$ grams. Find a 95% confidence interval of the mean birth weight of full-term babies. Interpret this confidence interval. State the formula used.

10. Studies show that gasoline use for compact cars sold in the United States is normally distributed. A random sample of 10 compact cars had an average of 27 miles per gallon (mpg) and a standard deviation of 4.5 mpg. Find a 99% confidence interval of the mean mpg of the compact cars in the United States. State the formula used.

11. An economist wishes to estimate the mean US household income. What size sample should she obtain if she wishes to limit the margin of error to $3500 with a level of confidence of 98%? Assume that a preliminary sample indicated that the standard deviation of US household income is $11,500. State the formula before calculating the sample size.

12. The packaging of an E.P.T. Pregnancy Test states that the test is "99% accurate at detecting typical pregnancy hormone levels." For legal reasons, we think the manufacturer underestimates the accuracy of the E.P.T. Pregnancy Test. To test this, we randomly select 15,700 women and test them using both E.P.T. Pregnancy Test and a blood test. The blood test indicates that 1405 women are pregnant and E.P.T. Pregnancy Test gives a positive result for 1398 of those pregnant women. At the significance level $\alpha = 0.05$, do we have enough evidence to claim that the E.P.T. Pregnancy Test is more than 99% accurate? Show the test completely and clearly.

13. Suppose a lobbying group claims that a referendum for legalizing medical marijuana will pass. To test this hypothesis, suppose we randomly sampled 425 likely voters and found that 185 will vote in favor of legalizing medical marijuana. At the significance level $\alpha = 0.05$, do we have enough evidence to reject the lobbying group's claim? Show the test completely and clearly.

14. It is claimed that the proportion of vegetarians in India is about 48%. To test if this is true, suppose a random survey of 600 Indians indicated that 248 of them are vegetarians. At the significance level $\alpha = 0.01$, do we have enough evidence to reject the proportion of vegetarians in India at being 48%? Show the test completely and clearly.

15. A medical report claims that the birth weights of full-term babies is now more than 3,500 grams. A random sample of 72 full-term babies indicated a mean birth weight of $\overline{x} = 3,450$ grams and a standard deviation of $s = 510$ grams. Based on this data, can we reject this medical report's claim at $\alpha = 0.05$ significance level? Show the test completely and clearly.

16. A report claims that mean gasoline use for compact cars sold in the United States is 25.5 miles per gallon (mpg). A random sample of 10 compact cars had an average of 27 miles per gallon (mpg) and a standard deviation of 4.5 mpg. Based on this data, can we reject this report's claim at $\alpha = 0.01$ significance level? Assume that the gasoline use for compact cars sold in the United States is normally distributed. Show the test completely and clearly.

17. An economic report claims that mean inflation adjusted hourly wages of young college graduates is lower than it was back in 1990. The hourly wages of young college graduate in 1990 was \$16.59 per hour. Suppose, in 2015, a random sample of 81 young college graduates shows a mean inflation adjusted hourly wage of \$17.03 with a standard deviation of \$2.85. Based on this data, can we reject this economic report's claim at $\alpha = 0.05$ significance level? Show the test completely and clearly.

Just Answers To Additional (not on the Sample Exam) Review Problems for Chapters 8-10

The following are just answers, not complete solutions!

1. (a) wider (b) Type I error or rejecting H_0 when H_0 is true (c) $\frac{\sigma}{6}$ (d) p (e) not rejecting (f) 0.5
2. (a) True (b) True (c) False (d) True (e) True (f) False
3. (a) $\overline{x}$ is normally distributed with mean $\mu_{\overline{x}} = 14500$ and $\sigma_{\overline{x}} = 901.56$ (b) $P(\overline{x} < 13700) \approx P(Z < -0.89) = 0.1867$
4. $P(\overline{x} > 0.785) \approx P(Z > 2.38) = 0.0087$
5. (a) Since $n = 132 \leq 5\%N$ and $np(1-p) = 11.89 \geq 10$, $\hat{p}$ is normally distributed with mean $\mu_{\hat{p}} = 0.1$ and $\sigma_{\hat{p}} = 0.0261$ (b) $P(\hat{p} > 0.07) \approx P(Z > -1.15) = 0.8749$
6. Since $n = 80 \leq 5\%N$ and $np(1-p) = 18.2 \geq 10$, $P(\hat{p} < 0.3) \approx P(Z < -1.97) = 0.0244$
7. C.I. bounds are $\hat{p} \pm Z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} = \frac{281}{1200} \pm 1.96 \sqrt{\frac{\frac{281}{1200}(1-\frac{281}{1200})}{1200}}$, C.I. = (21.0%, 25.8%)
8. (a) $n = 0.25 \left(\frac{Z_{\frac{\alpha}{2}}}{E}\right)^2$, $n = 4145$ (b) $n = \hat{p}(1-\hat{p}) \left(\frac{Z_{\frac{\alpha}{2}}}{E}\right)^2$, $n = 1726$
9. C.I. bounds are $\overline{x} \pm t_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}} \approx 3450 \pm 1.994 \frac{510}{\sqrt{72}}$, C.I. = (3330.2, 3569.8). We are 95% confident that the mean birth weight is in this interval or 95% of confidence intervals for samples of size 72 will contain the actual mean birth weight.
10. C.I. bounds are $\overline{x} \pm t_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}} = 27 \pm 3.250 \frac{4.5}{\sqrt{10}}$, C.I. = (22.38, 31.62).
11. $n = \left(\frac{Z_{\frac{\alpha}{2}} s}{E}\right)^2 = \left(\frac{2.33 \times 11500}{3500}\right)^2$, $n = 59$
12. $H_0 : p = p_0 = 0.48$, $H_1 : p \neq 0.48$; $z_0 = -2.473$; Can not reject H_0 since $-z_{0.005} = -2.575 < z_0 = -2.473 < 2.575 = z_{0.005}$.
13. $H_0 : p = p_0 = 0.99$, $H_1 : p > 0.99$; $z_0 = 2.673$; Reject H_0 since $z_0 = 2.673 > 1.645 = z_{0.05}$.
14. $H_0 : p = p_0 = 0.50$, $H_1 : p < 0.50$; $z_0 = -2.69$; Reject H_0 since $z_0 = -2.69 < -2.335 = -z_{0.01}$.
15. $H_0 : \mu = \mu_0 = 3500$, $H_1 : \mu < 3500$; $t_0 = -0.832$; Can not reject H_0 since $t_0 = -0.832 \not< -1.677 \approx -t_{0.05}$ with df = 71.
16. $H_0 : \mu = \mu_0 = 25.5$, $H_1 : \mu \neq 25.5$; $t_0 = 1.054$; Can not reject H_0 since $-3.250 = -t_{0.005} < t_0 = 1.054 < 3.250 = t_{0.005}$ with df = 9.
17. $H_0 : \mu = \mu_0 = 16.59$, $H_1 : \mu > 16.59$; $t_0 = 1.389$; Can not reject H_0 since $t_0 = 1.389 \not> 1.664 = t_{0.05}$ with df = 80.